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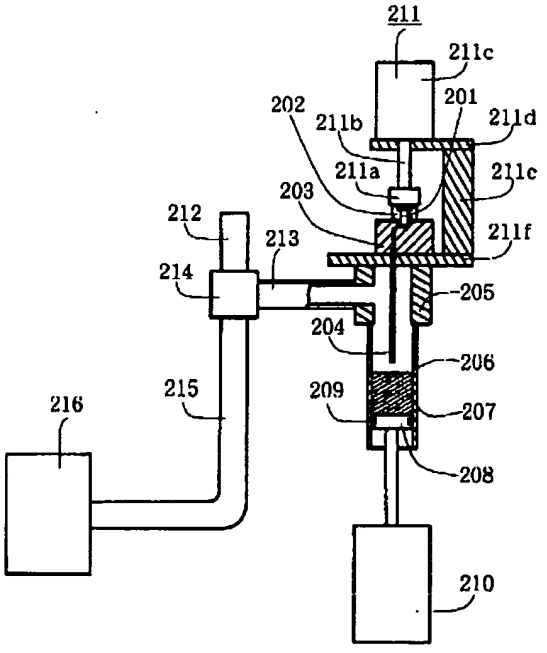
(54)【発明の名称】　流体動圧軸受の流体注入装置

(57)【要約】
【課題】真空注入法を用い液面制御手段を備える流体動圧軸受の流体注入装置において、ベローズ等の高価な交換部品を必要としない液面制御手段を提供すること。
【解決手段】本発明に係る流体注入装置を、流体動圧軸受（２０１、２０２）が着座する○リングを備えた軸受保持台２０３と、軸受固定手段２１１と、前記流体動圧軸受の内部を減圧する真空ポンプ２１６と、潤滑用流体２０７が貯蔵されたリザーバ２０６と、潤滑用流体２０７を注入する流体注入チューブ２０４と、減圧時には前記流体注入チューブ２０４の先端から離れた第１レベルに且つ注入時には前記流体注入チューブの先端が没する第２レベルに前記潤滑用流体の液面を制御する液面制御手段とで構成し、且つ、前記液面制御手段を、シリンダーとなるリザーバ２０６の内周面と、この内周面に嵌合するピストン２０８と、このピストンを駆動する油圧又は空気圧シリンダー２１０とで構成した。



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【特許請求の範囲】

【請求項１】　軸受保持面に流体動圧軸受の所定の面が着座するＯリングを備えた軸受保持台と、前記流体動圧軸受を前記軸受保持台に載置して固定する軸受固定手段と、前記流体動圧軸受の所定の面と前記軸受保持面及び前記Ｏリングとで形成されたシール空間を介して前記流体動圧軸受の内部を減圧する真空ポンプと、潤滑用流体が貯蔵されたリザーバと、前記流体動圧軸受の内部に前記シール空間を介して前記潤滑用流体を注入する流体注入チューブと、減圧時には前記流体注入チューブの先端から離れた第１レベルに且つ注入時には前記流体注入チューブの先端が没する第２レベルに前記潤滑用流体の液面を制御する液面制御手段とから構成された流体動圧軸受の流体注入装置において、前記液面制御手段は前記リザーバに貯蔵されている潤滑用流体の液面のレベル自体を制御するものであることを特徴とする流体動圧軸受の流体注入装置。

【請求項２】　前記液面制御手段が、前記リザーバの内周面と、これに嵌合するピストンと、前記ピストンを駆動する駆動手段とから構成されたものであることを特徴とする請求項１の流体動圧軸受の流体注入装置。

【請求項３】　前記液面制御手段が、前記リザーバと補助リザーバとこれら２つのリザーバの間で潤滑用流体を移動させるポンプとから構成されたものであることを特徴とする請求項１の流体動圧軸受の流体注入装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、真空注入法を用いて流体動圧軸受に潤滑用流体を注入する流体動圧軸受の流体注入装置の改良に関する。

【０００２】

【従来の技術】流体動圧軸受は、例えば図６に示す如く、円柱部材２にスラスト部材であるリング部材３が圧入されて形成されたフランジ付シャフト１と、このフランジ付シャフト１が回転自在に嵌合する段付円筒状スリーブ４と、スラスト押さえ部材としても機能する環状蓋部材５とから構成されており、これらの軸受構成部材間に形成された微小隙間Ｒ１、Ｒ２、Ｒ３、Ｒ４及びＲ５には潤滑油Ｆが充填されている。円柱部材２の上側の外周面と環状蓋部材５の内周面との間に形成されたテーパー状微小隙間Ｓは、毛細管現象と表面張力を利用して潤滑油Ｆが外部に漏出しないように機能するキャピラリーシールである。円柱部材２の下側の外周面にはヘリングボーン溝の如きラジアル動圧溝Ｇ１が形成され、リング部材３の上面と下面にはヘリングボーン溝の如きスパイラルのスラスト動圧発生溝Ｇ２がそれぞれ形成されている。前記テーパー状微小隙間Ｓは、微小隙間Ｒ１、Ｒ２、Ｒ３、Ｒ４及びＲ５が連通して形成している片袋状流体充填部の唯一の開口であって、潤滑油Ｆの注入口となっている。なお、図７に、スラスト動圧発生溝Ｇ２の一例を示す。

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【０００３】要するに、流体動圧軸受は、シャフトとスリーブを含む軸受構成部材と、これら軸受構成部材間に形成されたラジアル隙間とスラスト隙間を含む片袋状流体充填部に潤滑用流体が充填され、且つ前記ラジアル隙間にはラジアル動圧発生溝が形成され、前記スラスト隙間にはスラスト動圧発生溝が形成されて構成された動圧軸受である。

【０００４】小型薄型の流体動圧軸受の微小隙間は数μｍ～数１００μｍであるから、潤滑用流体は真空注入法によって流体動圧軸受内に注入される。真空注入法を用いた従来装置として、米国特許第５８６２８４１号に開示された潤滑用流体注入装置がある。

【０００５】この従来装置は、図５に示す如く、軸受保持面に流体動圧軸受２７の所定の面が着座するＯリングを備えた軸受保持台７０と、流体動圧軸受２７を軸受保持台７０に載置して固定する軸受固定手段４４等と、流体動圧軸受２７の所定の面と前記軸受保持面及び前記Ｏリングとで形成されたシール空間を介して流体動圧軸受２７の内部を減圧する真空ポンプ５２と、潤滑用流体が貯蔵されたリザーバ７４と、流体動圧軸受２７の内部に前記シール空間を介して前記潤滑用流体を注入する流体注入チューブ９０と、減圧時には流体注入チューブ９０の先端から離れた第１レベルに且つ注入時には流体注入チューブ９０の先端が没する第２レベルに前記潤滑用流体の液面を制御する液面制御手段とから構成された流体動圧軸受の流体注入装置である。

【０００６】そして、前記液面制御手段は、ベローズ８０を介してリザーバ７４を軸受固定手段４４に取りつけると共に、軸受固定手段４４に油圧又は空気圧シリンダーで駆動されるアクチュエータ７８が取りつけられ、このアクチュエータ７８によってリザーバ７４を矢印に示す如く上下に移動させることによって行うものである。即ち、前記液面制御手段は、潤滑用流体が貯蔵されているリザーバの上下の位置を制御するものであるから、比較的複雑な構造の装置である。しかも、ベローズ８０は、内部圧力が５０mTorr以下になっても変形しない強度を持ち、且つ頻繁な伸縮に長期間耐えられる耐久性の高いベローズを用いる必要がある。しかしながら、このような耐久性の高いベローズは非常に高価であるという問題があった。しかも、どのように耐久性の高いベローズであっても適切な頻度で交換しなければならない。従って、従来の流体注入装置には、面倒なメンテナンスと交換部品の費用が発生するという問題もある。

【０００７】

【発明が解決しようとする課題】本発明が解決しようとする課題は、真空注入法を用い液面制御手段を備える流体動圧軸受の流体注入装置において、高価な交換部品を必要としない液面制御手段を採用し、メンテナンスの頻度を激減させ、且つコストを低減させることである。

【０００８】上記課題を解決する流体動圧軸受の流体注入装置を、軸受保持面に流体動圧軸受の所定の面が着座するＯリングを備えた軸受保持台と、前記流体動圧軸受を前記軸受保持台に載置して固定する軸受固定手段と、前記流体動圧軸受の所定の面と前記軸受保持面及び前記Ｏリングとで形成されたシール空間を介して前記流体動圧軸受の内部を減圧する真空ポンプと、潤滑用流体が貯蔵されたリザーバと、前記流体動圧軸受の内部に前記シール空間を介して前記潤滑用流体を注入する流体注入チューブと、減圧時には前記流体注入チューブの先端から離れた第１レベルに且つ注入時には前記流体注入チューブの先端が没する第２レベルに前記潤滑用流体の液面を制御する液面制御手段とで構成し、前記液面制御手段は前記リザーバに貯蔵されている潤滑用流体の液面自体を制御する手段とした。

【０００９】そして、前記液面制御手段としては、前記リザーバの内周面と、これに嵌合するピストンと、前記ピストンを駆動する駆動手段とから構成されたもの、又は前記リザーバと補助リザーバとこれら２つのリザーバの間で潤滑用流体を移動させるポンプとから構成されたものを採用した。

【００１０】

【発明の実施の形態】図１と図２は、シャフト２０１とスリーブ２０２を有する流体動圧軸受に潤滑用流体を注入する本発明の第１実施形態の要部を断面で示した構成図、図４はその部分拡大断面図である。

【００１１】これらの図において、第１実施形態の流体動圧軸受の流体注入装置は、軸受保持面となる上面に流体動圧軸受の所定の面が着座するＯリング２２０を備え且つその上面と下面とを貫通する流体注入用連通路２０３ｂが形成された軸受保持台２０３と、流体動圧軸受を軸受保持台２０３に固定する軸受固定装置２１１と、チャンバ２０５と、潤滑用流体２０７が貯蔵されたリザーバ２０６を含む。

【００１２】更に、第１実施形態の流体動圧軸受の流体注入装置は、チャンバ２０５に一端を接続されて真空圧又は大気圧を切り替えて導入する圧力導入パイプ２１３と、圧力導入パイプ２１３の他端に接続パイプ２１５を経て接続された真空ポンプ２１６と、一端が流体注入用連通路２０３ｂの下側端部に接続され且つ他端がリザーバ２０６内に延伸して配置された流体注入チューブ２０４と、リザーバ２０６に貯蔵された潤滑用流体２０７の液面を流体注入チューブ２０４の他端が没しない第１レベルと流体注入チューブ２０４の他端が没する第２レベルに切り替えて制御する液面制御手段を含んでいる。また、軸受保持台２０３の上面には流体注入用連通路２０３ｂの上端が開口している凹部２０３ａが形成されている。

【００１３】リザーバ２０６は、チャンバ２０５の下側開口にその上側開口を密着して固定されて一体化されたシール空間を形成している。このリザーバ２０６とチャンバ２０５とで形成したシール空間において、図１は潤滑用流体２０７の液面が第１レベルにある状態を示しており、図２は潤滑用流体２０７の液面が第２レベルにある状態を示している。

【００１４】この液面のレベルを制御するのが、その外周面にＯリング２０９が取りつけられたピストン２０８である。そして、リザーバ２０６の内周面はピストン２０８を受けるシリンダー面となっている。ピストン２０８は油圧又は空気圧シリンダー２１０で駆動される。即ち、第１実施形態における液面制御手段は、ピストンとシリンダーで構成されている。なお、切り替え弁２１４には接続パイプ２１２の一方の端部と接続パイプ２１５の一方の端部が夫々接続されている。また、一端がチャンバ２０５に接続されている圧力導入パイプ２１３の他端も切り替え弁２１４に接続されている。接続パイプ２１２の他端は大気に開口しており、接続パイプ２１５の他端は真空ポンプに接続されている。

【００１５】図３は、シャフト２０１とスリーブ２０２を有する流体動圧軸受に潤滑用流体を注入する本発明の第２実施形態の要部を断面で示した構成図、図４はその部分拡大断面図である。これらの図において、流体動圧軸受の流体注入装置は、液面制御手段を除けば、第１実施形態と基本的には同じ構成である。

【００１６】即ち、第２実施形態の流体動圧軸受の流体注入装置は、軸受保持面となる上面に流体動圧軸受との所定の面が着座するＯリング２２０を備え且つその上面と下面とを貫通する流体注入用連通路２０３ｂ(図４参照)が形成された軸受保持台２０３と、流体動圧軸受を軸受保持台２０３に固定する軸受固定装置２１１と、チャンバ２０５と、リザーバ３０１と、潤滑用流体２０７が貯蔵されたリザーバ３０１を含む。また、軸受保持台２０３の上面には流体注入用連通路２０３ｂの上端が開口している凹部２０３ａが形成されている。

【００１７】更に、第２実施形態の流体動圧軸受の流体注入装置は、チャンバ２０５に一端を接続されて真空圧又は大気圧を切り替えて導入する圧力導入パイプ２１３と、圧力導入パイプ２１３の他端に接続パイプ２１５を経て接続された真空ポンプ２１６と、一端が流体注入用連通路２０３ｂの下側端部に接続され且つ他端がリザーバ３０１内に延伸して配置された流体注入チューブ２０４と、リザーバ３０１に貯蔵された潤滑用流体２０７の液面を流体注入チューブ２０４の他端が没しない第１レベルと流体注入チューブ２０４の他端が没する第２レベルに切り替えて制御する液面制御手段とを含んでいる。

【００１８】リザーバ３０１は、チャンバ２０５の下側開口にその上側開口を密着して固定されて一体化されたシール空間を形成している。このリザーバ３０１とチャンバ２０５とで形成したシール空間において、図３は潤滑用流体２０７の液面が第１レベルにある状態を示して

いる。

【００１９】第２実施形態における液面制御手段は、リザーバ３０１と、補助リザーバ３０３と、これら２つのリザーバの間で潤滑用流体２０７を移動させるポンプ３０２とから構成されたものである。

【００２０】第１実施形態及び第２実施形態の流体動圧軸受の流体注入装置において、軸受固定装置２１１は、上部水平支持板２１１ｄ並びに下部水平支持板２１１ｆと、これらの水平支持板の間を隔てる間隔部材２１１ｅとからなる支持部と、上部水平支持板２１１ｄに載置され固定されたモータ２１１ｃ、モータ２１１ｃの回転軸に固着された駆動軸２１１ｂ、及び駆動軸２１１ｂの先端に取り付けられた軸受押さえ部材２１１ａとから構成されている。下部水平支持板２１１ｆはチャンバ２０５の上蓋としても機能している。

【００２１】次に、第１実施形態及び第２実施形態の流体注入装置は、概ね、以下の動作を順に実行し、流体動圧軸受に潤滑用流体を注入する。

（１）流体動圧軸受（２０１、２０２）を、そのキャピラリーシール部を下にして、軸受保持台２０３のＯリング２２０に着座させる。

（２）軸受固定装置２１１のモータ２１１ｃを駆動し、軸受押さえ部材２１１ａによって流体動圧軸受（２０１、２０２）を軸受保持台２０３に固定する。

（３）切り替え弁２１４を操作して、圧力導入パイプ２１３を接続パイプ２１５に切り替えて接続し、チャンバ２０５を真空ポンプ２１６に接続する。

（４）真空ポンプ２１６を駆動して、流体動圧軸受（２０１、２０２）の内部を減圧する。

（５）液面制御手段によりリザーバ内の潤滑用流体２０７の液面を第２レベルに上げて、流体注入チューブ２０４の先端を潤滑用流体２０７内に浸す。

（６）切り替え弁２１４を操作して、圧力導入パイプ２１３を接続パイプ２１２に切り替えて接続し、チャンバ２０５内に大気圧を導入する。

（７）チャンバ２０５内の大気圧によって、流体動圧軸受（２０１、２０２）の内部に潤滑用流体２０７が流体注入チューブ２０４を通って注入される。

（８）液面制御手段によりリザーバ内の潤滑用流体２０７の液面を第１レベルに下げて、流体注入チューブ２０４の先端を潤滑用流体２０７から離す。

（９）軸受固定装置２１１のモータ２１１ｃを駆動し、軸受押さえ部材２１１ａを開放位置に上昇させ、流体動圧軸受（２０１、２０２）を軸受保持台２０３から取り外す。

上記のモータ２１１ｃ、切り替え弁２１４、真空ポンプ２１６及び液面制御手段の動作は、図示しないシーケンス制御装置によって自動的に制御される。

【００２２】上記（５）と（７）の液面制御は、第１実施形態においては、リザーバ２０６の内周面と、これに

嵌合するピストン２０８と、ピストン２０８を駆動する油圧又は空気圧シリンダー２１０を含む液面制御手段によって行われる。また、第２実施形態においては、リザーバ３０１と補助リザーバ３０２とこれら２つのリザーバの間で潤滑用流体２０７を移動させるポンプ３０２とから構成された液面制御手段によって行われる。

【００２３】

【発明の効果】本発明は、真空注入法を用い液面制御手段を備える流体動圧軸受の流体注入装置において、リザーバに貯蔵されている潤滑用流体の液面のレベル自体を制御するものであるから、ベローズ等の高価な交換部品を必要としないので、メンテナンスが容易で、且つ装置と維持のコストを低減させることができた。

【図面の簡単な説明】

【図１】第１実施形態の流体注入装置の要部を断面で示した構成図である。但し、液面が第１レベルにある状態を示す。

【図２】第１実施形態の流体注入装置の要部を断面で示した構成図である。但し、液面が第２レベルにある状態を示す。

【図３】第２実施形態の流体注入装置の要部を断面で示した構成図である。但し、液面が第１レベルにある状態を示す。

【図４】第１実施形態及び第２実施形態の流体注入装置の要部拡大断面図である。但し、流体動圧軸受は流体注入が完了した状態で示してある。

【図５】従来の流体注入装置の構成図である。

【図６】潤滑用流体が注入される流体動圧軸受の一実施例の断面図である。但し、微小隙間は誇張して示してある。

【図7】スラスト動圧発生溝Ｇ２の一例を示した図である。

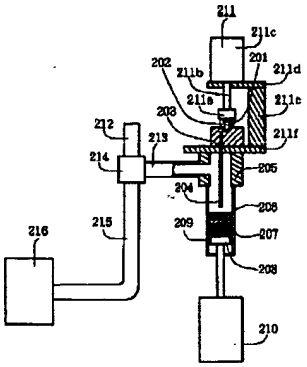
【符号の説明】

２７　流体動圧軸受
４４　軸受固定手段
５２　真空ポンプ
７０　軸受保持台
７４　リザーバ
８０　ベローズ
９０　流体注入チューブ
２０１　流体動圧軸受のシャフト
２０２　流体動圧軸受のスリーブ
２０３　軸受保持台
２０４　流体注入チューブ
２０５　チャンバ
２０６　リザーバ
２０７　潤滑用流体
２０８　ピストン
２０９　Ｏリング
２１０　油圧又は空気圧シリンダー

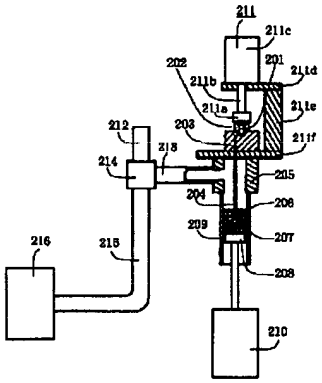
7　　8

２１１　軸受固定手段
２１２　接続パイプ
２１３　圧力導入パイプ
２１４　切り替え弁
２１５　接続パイプ
＊２１６　真空ポンプ
２２０　Ｏリング
３０１　リザーバ
３０２　ポンプ
＊　３０３　補助リザーバ

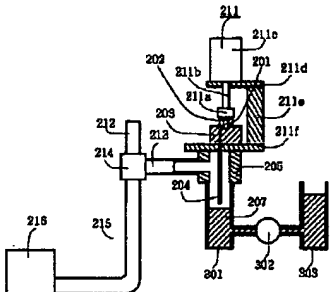
【図１】



【図２】

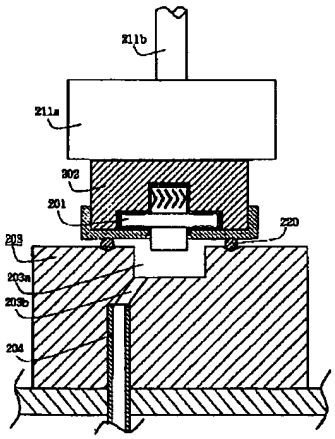


【図３】

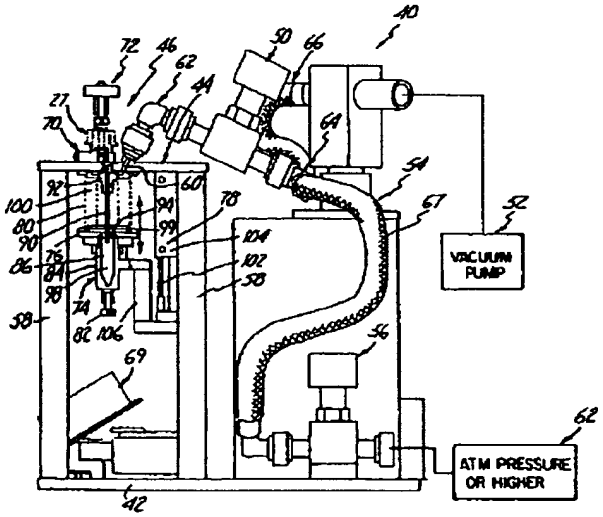


【図７】

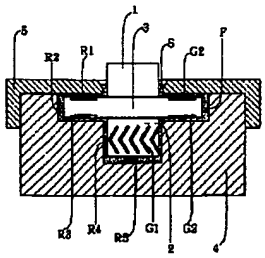
【図４】



【図５】



【図６】



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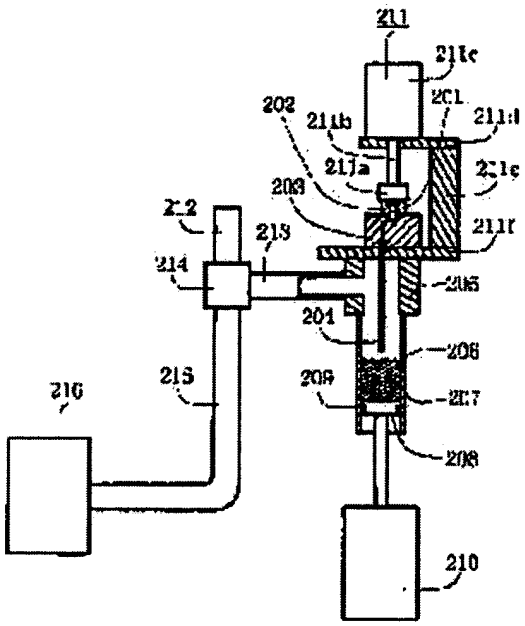
(54) FLUID INJECTION APPARATUS OF FLUID DYNAMIC PRESSURE BEARING

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a level control means without requiring expensive replacement parts such as bellows or the like, in a fluid injection apparatus of fluid dynamic pressure bearings using a vacuum injection method and having the liquid level control means.

SOLUTION: The fluid injection apparatus of this invention comprises: a bearing holding base 203 having an O-ring on which fluid dynamic pressure bearings (201, 202) seat; a bearing fixing means 211; a vacuum pump 216 for reducing the pressure in the fluid dynamic bearings; a reservoir 206 for storing lubricating fluid 207; a fluid injection tube 204 for injecting the lubricating fluid 207; and the level control means for controlling the level of the lubricating fluid to be a first level spaced from the tip of the fluid injection tube 204 at the time of reducing the pressure in the fluid dynamic pressure bearings, and to be a second level



at which the tip of the fluid injection tube sinks in the liquid at the time of injecting the lubricating fluid. Further, the level control means is constituted by an inner circumferential face of the reservoir 206 as a cylinder, a piston 208 fitted in the inner circumferential face thereof, and a hydraulic or pneumatic cylinder 210 for driving the piston.

LEGAL STATUS

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[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

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CLAIMS

[Claim(s)]

[Claim 1] The bearing maintenance base which equipped the bearing maintenance side with the O ring with which the predetermined field of a fluid hydrodynamic bearing sits down, A

bearing fixed means to lay said fluid hydrodynamic bearing in said bearing maintenance base, and to fix, The vacuum pump which decompresses the interior of said fluid hydrodynamic bearing through the seal space formed with the field, said predetermined bearing maintenance side, and said predetermined O ring of said fluid hydrodynamic bearing, The reservoir with which the fluid for lubrication was stored, and the fluid impregnation tube which pours said fluid for lubrication into the interior of said fluid hydrodynamic bearing through said seal space, And it sets to the fluid injector of the fluid hydrodynamic bearing which consisted of liquid-level-control means to control the oil level of said fluid for lubrication on the 2nd level which the tip of said fluid impregnation tube hides, at the time of impregnation. the 1st level which is distant from the tip of said fluid impregnation tube at the time of reduced pressure -- Said liquid-level-control means is the fluid injector of the fluid hydrodynamic bearing characterized by being what controls the level of the oil level of the fluid for lubrication stored in said reservoir itself.
[Claim 2] The fluid injector of the fluid hydrodynamic bearing of claim 1 characterized by said liquid-level-control means consisting of inner skin of said reservoir, a piston which fits into this, and a driving means which drives said piston.
[Claim 3] The fluid injector of the fluid hydrodynamic bearing of claim 1 characterized by said liquid-level-control means consisting of pumps to which the fluid for lubrication is moved between said reservoir, auxiliary reservoir, and these two reservoirs.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to amelioration of the fluid injector of the fluid hydrodynamic bearing which pours the fluid for lubrication into a fluid hydrodynamic bearing

using the vacuum pouring-in method.

[0002]

[Description of the Prior Art] A fluid hydrodynamic bearing For example, the shaft 1 with a flange by which the ring member 3 which is a thrust member was pressed fit and formed in the cylinder member 2 as shown in drawing 6 , This shaft 1 with a flange consists of a cylindrical-with stage sleeve 4 which fits in free [rotation], and annular covering device material 5 which functions also as a thrust presser-foot member, and the minute clearances R1, R2, R3, R4, and R5 formed among these bearing configuration members are filled up with the lubricating oil F. The taper-like minute clearance S formed between the peripheral face of the cylinder member 2 top and the inner skin of the annular covering device material 5 is a capillary tube seal which functions as a lubricating oil F not leaking out outside using capillarity and surface tension. The radial dynamic pressure slot G1 like a herringbone slot is formed in the peripheral face of the cylinder member 2 bottom, and the thrust dynamic pressure generating slot G2 of the spiral like a herringbone slot is formed in the top face and inferior surface of tongue of the ring member 3, respectively. Said taper-like minute clearance S is the only opening of the piece saccate fluid restoration section which the minute clearances R1, R2, R3, R4, and R5 open for free passage and form, and serves as an inlet of a lubricating oil F. In addition, an example of the thrust dynamic pressure generating slot G2 is shown in drawing 7 .

[0003] In short, a fluid hydrodynamic bearing is a hydrodynamic bearing which the piece saccate fluid restoration section including the radial internal clearance formed between the shaft, the bearing configuration member containing a sleeve, and these bearing configuration member and a thrust clearance was filled up with the fluid for lubrication, and the radial dynamic pressure generating slot was formed in said radial internal clearance, and the thrust dynamic pressure generating slot was formed in said thrust clearance, and was constituted.

[0004] Since the minute clearances between small thin fluid hydrodynamic bearings are several micrometers - 100 micrometers of numbers, the fluid for lubrication is poured in into a fluid hydrodynamic bearing by the vacuum pouring-in method. There is a fluid injector for lubrication indicated by U.S. Pat. No. 5862841 as equipment conventionally using the vacuum pouring-in method.

[0005] The bearing maintenance base 70 which equipped the bearing maintenance side with the O ring with which the predetermined field of the fluid hydrodynamic bearing 27 sits down conventionally [this] as equipment was shown in drawing 5 , The bearing fixed means 44 grade which lays the fluid hydrodynamic bearing 27 in the bearing maintenance base 70, and is fixed, The vacuum pump 52 which decompresses the interior of the fluid hydrodynamic bearing 27 through the seal space formed with the field, said predetermined bearing maintenance side, and said predetermined O ring of the fluid hydrodynamic bearing 27, The reservoir 74 with which the fluid for lubrication was stored, and the fluid impregnation tube 90

which pours said fluid for lubrication into the interior of the fluid hydrodynamic bearing 27 through said seal space, the 1st level which is distant from the tip of the fluid impregnation tube 90 at the time of reduced pressure -- and it is the fluid injector of the fluid hydrodynamic bearing which consisted of liquid-level-control means to control the oil level of said fluid for lubrication on the 2nd level which the tip of the fluid impregnation tube 90 hides, at the time of impregnation.

[0006] And the actuator 78 driven by oil pressure or the pneumatic cylinder for the bearing fixed means 44 is attached, and said liquid-level-control means is performed by making it move up and down, as this actuator 78 shows a reservoir 74 to an arrow head while attaching a reservoir 74 in the bearing fixed means 44 through bellows 80. That is, since said liquid-level-control means controls the location of the upper and lower sides of a reservoir in which the fluid for lubrication is stored, it is equipment of comparatively complicated structure. And it is necessary to use the bellows with high endurance which bellows 80 has the reinforcement which does not deform even if internal pressure is set to 50 or less mTorrs, and can be equal to frequent telescopic motion for a long period of time. However, the bellows with such high endurance had the problem of being very expensive. And however it may be bellows with high endurance, it must exchange by suitable frequency. Therefore, there is also a problem that the costs of a troublesome maintenance and a substitute part occur in the conventional fluid injector.

[0007]

[Problem(s) to be Solved by the Invention] The technical problem which this invention tends to solve is adopting the liquid-level-control means which does not need an expensive substitute part, and making the frequency of a maintenance decrease sharply, and reducing cost in the fluid injector of the fluid hydrodynamic bearing equipped with a liquid-level-control means using the vacuum pouring-in method.

[0008] The bearing maintenance base equipped with the O ring with which the predetermined field of a fluid hydrodynamic bearing sits down the fluid injector of the fluid hydrodynamic bearing which solves the above-mentioned technical problem to a bearing maintenance side, A bearing fixed means to lay said fluid hydrodynamic bearing in said bearing maintenance base, and to fix, The vacuum pump which decompresses the interior of said fluid hydrodynamic bearing through the seal space formed with the field, said predetermined bearing maintenance side, and said predetermined O ring of said fluid hydrodynamic bearing, The reservoir with which the fluid for lubrication was stored, and the fluid impregnation tube which pours said fluid for lubrication into the interior of said fluid hydrodynamic bearing through said seal space, And at the time of impregnation, it constitutes from a liquid-level-control means to control the oil level of said fluid for lubrication on the 2nd level which the tip of said fluid impregnation tube hides. the 1st level which is distant from the tip of said fluid impregnation tube at the time of

reduced pressure -- Said liquid-level-control means was made into a means to control the oil level of the fluid for lubrication stored in said reservoir itself.

[0009] And the thing which consisted of inner skin of said reservoir, a piston which fits into this, and a driving means which drives said piston as said liquid-level-control means, or the thing which consisted of pumps to which the fluid for lubrication is moved between said reservoir, auxiliary reservoir, and these two reservoirs was adopted.

[0010]

[Embodiment of the Invention] The block diagram and drawing 4 which showed the important section of the 1st operation gestalt of this invention which pours the fluid for lubrication into the fluid hydrodynamic bearing in which drawing 1 and drawing 2 have a shaft 201 and a sleeve 202 in the cross section are the partial expanded sectional view.

[0011] In these drawings the fluid injector of the fluid hydrodynamic bearing of the 1st operation gestalt The bearing maintenance base 203 in which free passage way 203b for fluid impregnation which equips the top face used as a bearing maintenance side with O ring 220 with which the predetermined field of a fluid hydrodynamic bearing sits down, and penetrates the top face and inferior surface of tongue was formed, The bearing locking device 211 which fixes a fluid hydrodynamic bearing to the bearing maintenance base 203, a chamber 205, and the reservoir 206 with which the fluid 207 for lubrication was stored are included.

[0012] Furthermore, the fluid injector of the fluid hydrodynamic bearing of the 1st operation gestalt The pressure installation pipe 213 which an end is connected to a chamber 205, and changes and introduces vaccum pressure or atmospheric pressure, The vacuum pump 216 connected to the other end of the pressure installation pipe 213 through the connection pipe 215, The fluid impregnation tube 204 with which the end was connected to the bottom edge of free passage way 203b for fluid impregnation, and the other end extended and has been arranged in a reservoir 206, A liquid-level-control means to change the oil level of the fluid 207 for lubrication stored in the reservoir 206 to the 1st level which the other end of the fluid impregnation tube 204 does not hide, and the 2nd level which the other end of the fluid impregnation tube 204 hides, and to control it is included. Moreover, crevice 203a the upper limit of free passage way 203b for fluid impregnation is carrying out [a] opening is formed in the top face of the bearing maintenance base 203.

[0013] The reservoir 206 forms the seal space which stuck the top opening, was fixed to bottom opening of a chamber 205 and was united with it. In the seal space formed by this reservoir 206 and chamber 205, the condition that the condition that drawing 1 has the oil level of the fluid 207 for lubrication in the 1st level is shown, and drawing 2 has the oil level of the fluid 207 for lubrication in the 2nd level is shown.

[0014] The piston 208 at which O ring 209 was attached in that peripheral face controls the level of this oil level. And the inner skin of a reservoir 206 is the cylinder side which receives a

piston 208. A piston 208 is driven by oil pressure or the pneumatic cylinder 210. That is, the liquid-level-control means in the 1st operation gestalt consists of a piston and a cylinder. In addition, one edge of the connection pipe 212 and one edge of the connection pipe 215 are connected to the change valve 214, respectively. Moreover, an end also changes the other end of the pressure installation pipe 213 connected to the chamber 205, and is connected to the valve 214. Opening of the other end of the connection pipe 212 is carried out to atmospheric air, and the other end of the connection pipe 215 is connected to the vacuum pump.

[0015] The block diagram and drawing 4 which showed the important section of the 2nd operation gestalt of this invention which pours the fluid for lubrication into the fluid hydrodynamic bearing in which drawing 3 has a shaft 201 and a sleeve 202 in the cross section are the partial expanded sectional view. In these drawings, the fluid injector of a fluid hydrodynamic bearing will be the same configuration as fundamentally as the 1st operation gestalt, if a liquid-level-control means is removed.

[0016] Namely, the fluid injector of the fluid hydrodynamic bearing of the 2nd operation gestalt The bearing maintenance base 203 in which free passage way 203b for fluid impregnation (refer to drawing 4) which equips the top face used as a bearing maintenance side with O ring 220 with which a predetermined field with a fluid hydrodynamic bearing sits down, and penetrates the top face and inferior surface of tongue was formed, The bearing locking device 211 which fixes a fluid hydrodynamic bearing to the bearing maintenance base 203, a chamber 205, a reservoir 301, and the reservoir 301 with which the fluid 207 for lubrication was stored are included. Moreover, crevice 203a the upper limit of free passage way 203b for fluid impregnation is carrying out [a] opening is formed in the top face of the bearing maintenance base 203.

[0017] Furthermore, the fluid injector of the fluid hydrodynamic bearing of the 2nd operation gestalt The pressure installation pipe 213 which an end is connected to a chamber 205, and changes and introduces vaccum pressure or atmospheric pressure, The vacuum pump 216 connected to the other end of the pressure installation pipe 213 through the connection pipe 215, The fluid impregnation tube 204 with which the end was connected to the bottom edge of free passage way 203b for fluid impregnation, and the other end extended and has been arranged in a reservoir 301, A liquid-level-control means to change the oil level of the fluid 207 for lubrication stored in the reservoir 301 to the 1st level which the other end of the fluid impregnation tube 204 does not hide, and the 2nd level which the other end of the fluid impregnation tube 204 hides, and to control it is included.

[0018] The reservoir 301 forms the seal space which stuck the top opening, was fixed to bottom opening of a chamber 205 and was united with it. In the seal space formed by this reservoir 301 and chamber 205, drawing 3 shows the condition that the oil level of the fluid 207

for lubrication is in the 1st level.

[0019] The liquid-level-control means in the 2nd operation gestalt consists of pumps 302 to which the fluid 207 for lubrication is moved between a reservoir 301, the auxiliary reservoir 303, and these two reservoirs.

[0020] In the fluid injector of the fluid hydrodynamic bearing of the 1st operation gestalt and the 2nd operation gestalt the bearing locking device 211 The supporter which becomes 211d list of top-horizontal-discharge support plates from spacing member 211e which separates between 211f of bottom-horizontal-discharge support plates, and these level support plates, It consists of bearing presser-foot member 211a attached at the tip of driving shaft 211b which fixed to the revolving shaft of motor 211c laid and fixed to 211d of top-horizontal-discharge support plates, and motor 211c, and driving shaft 211b. 211f of bottom-horizontal-discharge support plates is functioning also as a top cover of a chamber 205.

[0021] Next, the fluid injector of the 1st operation gestalt and the 2nd operation gestalt performs actuation of in general the following in order, and pours the fluid for lubrication into a fluid hydrodynamic bearing.

(1) Turn the capillary tube seal section down, and sit a fluid hydrodynamic bearing (201 202) to O ring 220 of the bearing maintenance base 203.

(2) Drive motor 211c of the bearing locking device 211, and fix a fluid hydrodynamic bearing (201 202) to the bearing maintenance base 203 by bearing presser-foot member 211a.

(3) Operate the change valve 214, change the pressure installation pipe 213 to the connection pipe 215, connect, and connect a chamber 205 to a vacuum pump 216.

(4) Drive a vacuum pump 216 and decompress the interior of a fluid hydrodynamic bearing (201 202).

(5) Raise the oil level of the fluid 207 for lubrication in a reservoir to the 2nd level with a liquid-level-control means, and dip the tip of the fluid impregnation tube 204 in the fluid 207 for lubrication.

(6) Operate the change valve 214, change the pressure installation pipe 213 to the connection pipe 212, connect, and introduce atmospheric pressure in a chamber 205.

(7) With the atmospheric pressure in a chamber 205, the fluid 207 for lubrication is poured into the interior of a fluid hydrodynamic bearing (201 202) through the fluid impregnation tube 204.

(8) Lower the oil level of the fluid 207 for lubrication in a reservoir to the 1st level with a liquid-level-control means, and separate the tip of the fluid impregnation tube 204 from the fluid 207 for lubrication.

(9) Drive motor 211c of the bearing locking device 211, raise bearing presser-foot member 211a to an open position, and remove a fluid hydrodynamic bearing (201 202) from the bearing maintenance base 203.

Actuation of the above-mentioned motor 211c, the change valve 214, a vacuum pump 216,

and a liquid-level-control means is automatically controlled by the sequence control equipment which is not illustrated.

[0022] The above (5) and liquid level control of (7) are performed in the 1st operation gestalt by the liquid-level-control means containing the oil pressure or the pneumatic cylinder 210 which drives the inner skin of a reservoir 206, the piston 208 which fits into this, and a piston 208. Moreover, it is performed in the 2nd operation gestalt by the liquid-level-control means which consisted of pumps 302 to which the fluid 207 for lubrication is moved between a reservoir 301, the auxiliary reservoir 302, and these two reservoirs.

[0023]

[Effect of the Invention] Since this invention controls the level of the oil level of the fluid for lubrication stored in the reservoir itself in the fluid injector of the fluid hydrodynamic bearing equipped with a liquid-level-control means using the vacuum pouring-in method and it did not need expensive substitute parts, such as bellows, the maintenance could be easy and was able to reduce the cost of equipment and maintenance.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram having shown the important section of the fluid injector of the 1st operation gestalt in the cross section. However, the condition that an oil level is in the 1st level is shown.

[Drawing 2] It is the block diagram having shown the important section of the fluid injector of the 1st operation gestalt in the cross section. However, the condition that an oil level is in the 2nd level is shown.

[Drawing 3] It is the block diagram having shown the important section of the fluid injector of

the 2nd operation gestalt in the cross section. However, the condition that an oil level is in the 1st level is shown.

[Drawing 4] It is the important section expanded sectional view of the fluid injector of the 1st operation gestalt and the 2nd operation gestalt. However, the fluid hydrodynamic bearing is shown where fluid impregnation is completed.

[Drawing 5] It is the block diagram of the conventional fluid injector.

[Drawing 6] It is the sectional view of one example of a fluid hydrodynamic bearing where the fluid for lubrication is poured in. However, the minute clearance is exaggerated and shown.

[Drawing 7] It is drawing having shown an example of the thrust dynamic pressure generating slot G2.

[Description of Notations]

27 Fluid Hydrodynamic Bearing
44 Bearing Fixed Means
52 Vacuum Pump
70 Bearing Maintenance Base
74 Reservoir
80 Bellows
90 Fluid Impregnation Tube
201 Shaft of Fluid Hydrodynamic Bearing
202 Sleeve of Fluid Hydrodynamic Bearing
203 Bearing Maintenance Base
204 Fluid Impregnation Tube
205 Chamber
206 Reservoir
207 Fluid for Lubrication
208 Piston
209 O Ring
210 Oil Pressure or Pneumatic Cylinder
211 Bearing Fixed Means
212 Connection Pipe
213 Pressure Installation Pipe
214 Change Valve
215 Connection Pipe
216 Vacuum Pump
220 O Ring
301 Reservoir
302 Pump

303 Auxiliary Reservoir

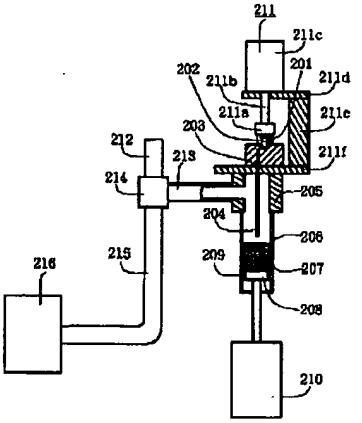
[Translation done.]

* NOTICES *

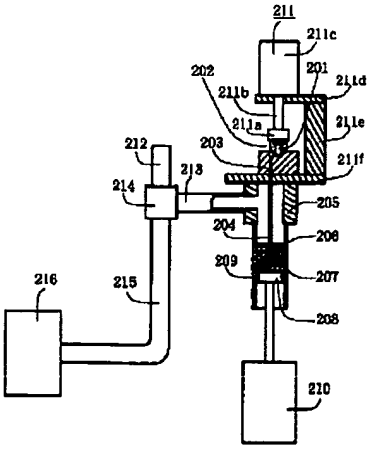
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

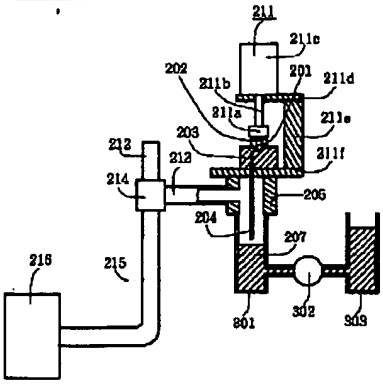
[Drawing 1]



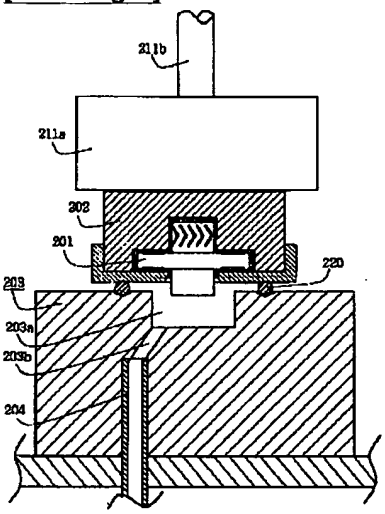
[Drawing 2]



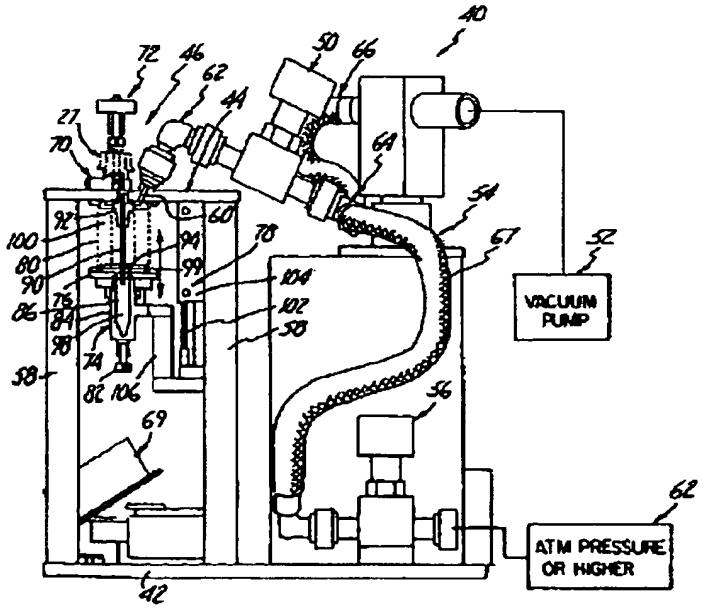
[Drawing 3]



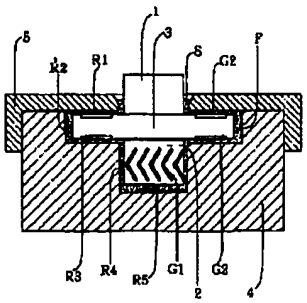
[Drawing 4]



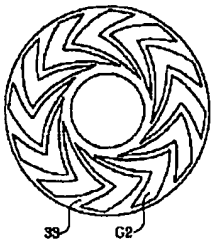
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]